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FREEZING POINT OF BENZOIC ACID AS A THERMOMETRIC FIXED POINT

Some months ago, experiments were completed on the use of the freezing point of benzoic acid as a practical substitute for the boiling point of water in the calibration of resistance thermometers and other temperature-measuring instruments. The acid, specially purified and sealed in an evacuated glass cell, freezes at 122.361°C . The observed freezing temperature is constant and reproducible to 0.001°C . This is a somewhat more exact reproduction of temperature than can be realized by observing the boiling temperature of water, except when the "steam point" is measured with the most refined apparatus. The greatest difficulty with an exact observation of the steam point arises from the necessity of measuring the barometric pressure very accurately. Freezing temperatures observed in evacuated cells are not affected by variations in barometric pressure, hence the new fixed point has the great advantage of requiring no barometric measurements whatever.

One of the cells used in the experimental development of the new fixed point was recently lent to a manufacturer of thermometers to determine its

usefulness in the actual control of the temperature scale which such manufacturers must maintain. The manufacturer reports that he finds it highly satisfactory and intends henceforth to use it in place of the steam point.

STANDARD SAMPLES OF HYDROCARBONS

At the urgent request of several organizations, chief of which is the Petroleum Industry War Council, through its Technical Advisory Committee, plans have been prepared for the provision by the Bureau of standard samples of hydrocarbons of a known high purity, for use in calibrating the following apparatus and instruments used in the petroleum, rubber, and allied industries:

Mass spectrometers.
Infrared spectrographs.
Ultraviolet spectrographs.
Raman spectrographs.
Refractometers.
Pycnometers and specific-gravity balances.
Boiling-point apparatus.
Freezing-point apparatus.
Molecular weight apparatus.
Bomb-combustion calorimeter for volatile liquids.

Actual operations are scheduled to begin July 1, 1943.

¹ Published with approval of the Director of the Budget.

NOTE ON THE SYSTEM



The following data were obtained by E. N. Bunting and R. F. Geller as part of an investigation now in progress of the system $\text{PbO}-\text{Al}_2\text{O}_3-\text{SiO}_2$. The Pb_2O_3 , heated in the range from 550° to 600° C, was obtained by holding basic lead carbonate of reagent quality at 230° C. The PbO , heated in the range from 595° to 475° C, was sublimed litharge containing 0.02 percent of total detected impurities. The materials were heated in platinum by means of an electrically heated furnace. The presence of Pb_2O_3 was indicated by its red color when present in more than small amounts. The presence of traces of Pb_2O_3 was shown by dissolving the sample in hydrochloric acid, adding freshly prepared potassium iodide solution, and testing for liberated iodine by adding starch solution.

Treatment of Pb_2O_3

Temperature	Duration	Oxide present
°C	hr	
550	47	Pb_2O_3 (no evidence of PbO).
575	23	Do.
585	23	Pb_2O_3 present (some change in color).
590	23	Mostly PbO (test shows Pb_2O_3 present).
595	23	Do.
600	23	PbO (no evidence of Pb_2O_3).

Treatment of PbO

Temperature	Duration	Oxide present
°C	hr	
595	23	PbO (no evidence of Pb_2O_3).
590	23	Do.
585	23	Do.
580	24	Do.
575	24	Do.
560	96	Do.

All the above data were obtained with partly closed platinum-foil capsules. The following tests were made with the PbO in open crucible.

Treatment		Oxide present
Temperature	Duration	
°C	Days	
525	3	Trace of Pb_2O_3 .
540	7	Do.
560	14	Weight showed 84% change to Pb_2O_3 .
475	7	Weight showed 70% change to Pb_2O_3 .

The results show that the reduction of Pb_2O_3 to PbO proceeded comparatively rapidly above 575° and was complete in 23 hr at 600°. The oxidation of PbO to Pb_2O_3 , however, proceeded very slowly in air at temperatures above about 525°. The speed of reaction at lower temperatures is probably a function of the surface exposed to circulating air.

TENSILE CRACKS IN AXIALLY REINFORCED CONCRETE CYLINDERS

In many instances, design tensile stresses for steel reinforcement in concrete are limited to values considerably below those warranted by strength considerations. The lower stresses are used when it is feared that higher values would result in cracks wide enough to cause leakage, corrosion, or unsightliness. Reduction of design tensile stresses is one method for minimizing the widths of cracks, but it is not the only one. A study of the factors that control the spacing and width of tensile cracks in symmetrically reinforced concrete members was completed recently by D. Watstein and D. E. Parsons, and the results are given in the July Journal of Research (RP1545).

Concrete cylinders of different sizes, and made with two concretes of widely different strengths, were cast with either one or two steel reinforcement bars along their axes. The reinforcement consisted of plain round, deformed, webbed Isteg, and threaded bars. These specimens were tested by applying tensile loads to the reinforcement which protruded from the ends of the cylinders. Observations were made of elongation of the concrete and the spacing and width of tensile cracks.

The factors governing the spacing and width of cracks in symmetrically reinforced concrete members subjected to axial forces were analyzed theoretically. The equations developed and the test data agreed well with respect to the effect of the principal factors, but the values of numerical coefficients which, according to theory, depend only on the distribution of bond stresses, were markedly affected by changes in the shape of the reinforcement bars. According to theory, the spacing of cracks is proportional to the ratio of the diameter of the reinforcement to the percentage of reinforcement in the concrete. It is also proportional to a coefficient which depends upon the shape of the reinforcement. The width of cracks is proportional to the spacing and to the difference between the tensile stress in the reinforcement at a crack

and a hypothetical stress called for convenience "stress at zero width of crack."

The results of the investigation indicate that a reduction of widths of cracks, as well as more economical use of steel reinforcement, would be likely to result from the development and general use of an improved type of deformed reinforcement bar for concrete.

COMMERCIAL MASONRY CEMENTS

At the time of the investigation of 41 commercial masonry cements reported in J. Research NBS 13, 811 (December 1934) RP746, additional mortar specimens were set aside for tests at a later age. Recently, Raymond L. Blaine made compression tests on 2-inch mortar cubes of these cements after both water and air storage for 10 years.

As reported in the July Journal of Research (RP1548), the compressive strengths of the 1 to 3 (cement to standard 20-30 sand) mortar cubes varied from 200 to 6,000 lb/in². The mortars made of cements originally classified as largely portland, portland plus unknown additions, and portland cement-hydrated lime mixes, had greater compressive strength at 10 years after air storage than after water storage. The mortars made of these types of cements had very little increase or a slight decrease in compressive strength between the periods of 1 and 10 years of water storage, but had appreciable strength increases in air storage for the same period. Mortars made of cements classified as natural cements, and largely slag cements had greater compressive strengths after water storage than after air storage. The mortars made of the natural cements increased only slightly in compressive strength while those made of the slag cements decreased slightly between the 1- and 10-year periods of air storage. The compressive strengths of the mortars made of the cements of the other classifications were too scattered to permit a general statement. The proportions of cement to sand and gradation of the sand affected both the 10-year strengths and the rate of strength increase between 28 days and 10 years. Many of the cements had lower compressive strength values at 10 years than at 1 year, under one or the other storage condition.

The linear expansion of the mortar specimens varied from 0 to 0.808 percent. Cements of greater magnesia contents showed a tendency toward greater expansion. All the mortar specimens made of cements having less

than 4 percent magnesia had linear expansions of less than 0.04 percent in 10 years of water storage.

ROOFING OF ARMY BUILDINGS

The Bureau has cooperated closely with the Repairs and Utilities Branch, Construction Division, Office of the Chief of Engineers, War Department, on problems connected with the maintenance of roofs and the reroofing of Army buildings.

The total area of the roofs of Army buildings is approximately 11,000,000 squares, equivalent to 39.5 square miles. These buildings were erected and their roofs applied with all possible speed. Of necessity, unseasoned lumber was frequently used for roof sheathing, and in many cases the roofs were applied at temperatures below freezing by inexperienced workmen. As a consequence, roofing has been one of the major problems of the Repairs and Utilities Branch, and promises to become more serious with time.

Following inspections of cantonment roofings in the Third and Fourth Service Commands early in 1942, the Bureau prepared the section on roofing of the Repairs and Utilities Manual, outlining methods for the repair and maintenance of all types of roofs and for reroofing when necessary.

Further inspections were made in the Eighth and Ninth Service Commands during last January and February. As a result of these inspections, it was estimated that about 10 percent of the total roof area will require reroofing during the fiscal year 1944 at a cost of approximately \$10,000,000. It was also estimated that 45 percent of the total area will require some repair during the same period, at a cost of \$5,500,000.

Following these inspections, additional instructions were prepared by the Bureau, outlining the conditions where reroofing is indicated, and giving further detailed methods of maintenance and repair. These have been sent to the Service Commands for distribution to all stations.

Every effort has been made to keep reroofing at a minimum, because it is realized that a general reroofing program would not only be uneconomical at present but would probably overtax the facilities of manufacturers as well as those of roofing contractors. In order to acquaint the personnel of each Service Command with the conditions that may be met in the field and to present the over-all picture of the Army roofing problems, it has been proposed to have a representative of the Bureau visit several stations in each Service

Command in company with the engineer who handles requests for roof repairs and reroofing.

LOW-TIN SOLDERS

In response to the current need for information on the utility of soft solders containing 20 percent or less of tin, as required by a recent WPB order, a practical study of the solders included in recent Federal and SAE Specifications is being conducted at the Bureau. A report by J. A. Kies and W. F. Roeser covering only the first phases of the investigation was presented at the annual meeting of the American Society for Testing Materials last month.

Six solders containing 20 to 50 percent of tin, small additions of antimony, bismuth, and copper, and the remainder lead, were studied. One of the 20-percent-tin solders contained 1.25 percent of silver. Spreading tests on copper showed the higher tin solders to best advantage, an advantage not maintained on black iron. Strength tests of simple lap joints, in sheet metals proved that for some practical applications the low-tin solders are just as strong as the old stand-bys. The main disadvantage of the low-tin solders is the relative difficulty in handling. The thickness of solder film for maximum strength of joint is no greater for a 20-percent-tin solder than for 50-50 solder.

ELECTROPLATING OF MILITARY SUPPLIES

The scarcity of metals such as copper, zinc, nickel, aluminum, and their alloys has led to the substitution of steel for many military supplies formerly made of these nonferrous metals. In most cases, the steel articles require protection against corrosion, which is frequently accomplished with electroplated coatings.

According to William Blum, chief of the Bureau's Electrochemistry Section, who delivered a paper entitled "Applications of electroplating to military supplies" at the meeting of the American Electroplaters' Society in Buffalo on June 7, relatively little nickel plating is now applied. Cadmium plating is extensively employed on fuse parts and airplane fittings, but zinc is substituted wherever possible. Lead plating is being used to an increasing extent, and chromium and silver coatings find many applications.

Camp tests on plated steel tableware show that resistance to abrasion is more important than protection against corrosion. Chromium coatings directly on

case-hardened steel are useful on both tableware and mess trays.

The electroplating of military equipment has absorbed the full capacity of most of the plants formerly engaged in plating civilian supplies.

USE OF SHORE DUROMETER FOR MEASURING HARDNESS OF RUBBER

Two recent developments have focused attention on the importance of the time factor in using the Shore Durometer for measuring the hardness of rubber. On the one hand, most of the synthetic rubbers now coming into large scale use exhibit considerably more creep than natural rubber, and this creep greatly increases the probability of obtaining large variations in the Durometer reading when the test is made by present methods. On the other hand, the Durometer reading has been made a requirement of many purchase specifications so that, whereas it was once regarded as an approximate measurement, it has now become a basis for the acceptance or rejection of large deliveries of rubber goods.

A paper describing tests made at the Bureau to show the effect of time on the Durometer readings was presented at the 46th annual meeting of the American Society for Testing Materials on June 28, by Rolla H. Taylor.

In this investigation the personal equation was eliminated by the use of mechanical means for applying the Durometer. Motion pictures of the instrument and a stop watch in the same field of view made possible a detailed study of the change in Durometer reading with time. Tests were made on 16 specimens representing 5 different types of synthetic rubber and two kinds of natural rubber, designed to cover the range of hardness for which the Shore Durometer is commonly used.

Curves drawn to represent the Durometer readings as a function of time all exhibit a rapid decrease of the reading during the first few seconds with progressively less change for succeeding time intervals. The general form of the curve is the same for all compositions but the amount of the decrease varies considerably and is in general much greater for synthetic than for natural rubber.

While these curves indicate the magnitude of the creep, they do not lend themselves well to evaluating the creep quantitatively. If, however, the Durometer readings are plotted against the logarithm of the time, curves are obtained which approximate straight lines, and their slopes may be taken as a

measure of creep. These slopes can also be determined approximately from readings at two time intervals, for instance, 3 and 30 seconds or 5 and 50 seconds.

Measurements were made at three different temperatures, and it was found that some specimens, particularly those from synthetic rubber, exhibited a sufficient change to require a specification of the temperature.

The following procedure was recommended when making hardness measurements with the Durometer:

1. Hold the Durometer in the recommended manner in the right hand with the indenter just touching the specimen and with the right wrist or forearm resting on the specimen or its support. Hold a watch in the left hand.

2. Make several trial applications to determine the minimum force required to seat the Durometer on the specimen.

3. At the desired time apply the Durometer as quickly as possible with the minimum required pressure; be careful to maintain constant pressure throughout the test and to hold the Durometer motionless.

4. Take the reading 30 ± 1 second after the application of the Durometer.

APPARATUS FOR TESTING SINGLE FIBERS

The study of the mechanical properties of single textile fibers has resulted in important scientific and technological advances; in particular, their load-elongation characteristics have been investigated to great advantage. However, these studies have been hampered by the lack of a convenient, accurate, and autographic apparatus capable of handling the small forces involved in the stretching of a single fiber. Recent work of research associates of the textile Foundation at the Bureau has led to the development of an apparatus which meets these requirements. As explained in the July Journal of Research (RP1546), it is adapted to making a continuous load-elongation record at constant rate of elongation and to making a point by point record at constant rate of loading.

It is also useful for obtaining relaxation curves for single fibers. The range of the instrument is such that all of the natural or synthetic fibers can be studied. Sensitive automatic operation is attained by means of photoelectric controls, and autographic recording in rectangular coordinates is provided. Examples of the performance of the apparatus are given in the report.

PROPERTIES OF GALACTURONIC ACID

Galacturonic acid is one of the most plentiful of the carbohydrates, occurring as a building unit, particularly in the plant pectins. Yet this substance, possibly because of the difficulties inherent in its separation and purification, has received much less attention than other commonly occurring carbohydrates. Recently, methods have been developed for the separation of galacturonic acid in good yield from commercial citrus pectic acid. The acid is still relatively expensive, but since the amount potentially available in so-called agricultural wastes is enormous, it seemed of interest to investigate some of its properties.

Galacturonic acid is a substituted aldose, capable of undergoing the reactions characteristic of the reducing sugars. In addition, as hydroxy-acid it can undergo lactone and ester formation, and thus possesses the ability to enter into a wide range of reactions. In the present investigation, which was conducted by Horace S. Isbell and Harriet L. Frush, certain physical and chemical properties of galacturonic acid have been studied. The optical rotation and mutarotation measurements which are reported in the July Journal of Research (RP1547), should provide useful data for analytical purposes. Comparisons of the mutarotations show that crystalline α - and β -D-galacturonic acid are an alpha-beta pair, analogous in structure to α - and β -D-galactopyranose.

Bromine oxidations have been conducted, and a study has been made of the optical rotations during and after oxidation. The results show that the oxidation products are optically active lactones of mucic acid. Since free mucic acid, if it were formed directly by the oxidation of galacturonic acid, would not yield an optically active lactone, the results are striking evidence that the ring forms of galacturonic acid are oxidized directly to the lactones of mucic acid without the intermediate formation of the open-chain modification of galacturonic acid or of mucic acid. A study of the oxidation products revealed that the delta lactone of mucic acid in water solution is hydrolyzed rapidly by barium carbonate, whereas the gamma lactone is hydrolyzed more slowly. The difference in reaction rates was used for estimating the relative quantities of the two oxidation products.

TABLES OF PLANCK'S RADIATION FUNCTIONS, AND ELECTRONIC FUNCTIONS

Mathematical Table MT17, prepared by the Work Projects Administration for the city of New York under the sponsorship of the Bureau, is in two parts, dealing with Planck's radiation functions and the electronic functions, respectively.

Part 1, which was originally published in the Journal of the Optical Society of America for February 1940, evaluates (in Tables I to IV) the functions:

$$R_\lambda = c_1 \lambda^{-5} (e^{c_2/\lambda T} - 1)^{-1}; R_{0-\lambda} = \int_0^\lambda R_\lambda d\lambda$$

$$N_\lambda = 2\pi c \lambda^{-4} (e^{c_2/\lambda T} - 1)^{-1}; N_{0-\lambda} = \int_0^\lambda N_\lambda d\lambda$$

$R_\lambda d\lambda$ is the energy emitted by a black body at absolute temperature, T , on the Kelvin scale, per unit time, per unit area, in a wavelength interval from λ to $\lambda + d\lambda$, throughout the solid angle 2π steradians.

$N_\lambda d\lambda$ represents the number of photons emitted in the wavelength range from λ to $\lambda + d\lambda$, per unit time, per unit area, throughout the solid angle 2π steradians.

The tables evaluate these four functions of λT not only relative to their maximum values, but also for $T = 1,000^\circ\text{K}$ in absolute units (ergs or photons per cm^2 per second). The values are given to five significant figures, first and second differences being provided to assist in finding R_λ and N_λ by interpolation; a convenient method of correcting for small changes in the value of c_2 from that ($c_2 = 1.436 \text{ cm K}^2$) used in computing the tables is included. The function N_λ is also evaluated for $T = 1,500^\circ, 2,000^\circ, 2,500^\circ, 3,000^\circ, 3,500^\circ$, and $6,000^\circ\text{K}$.

Part 2, a table of 28 pages, gives in five columns the values for the velocity of an electron relative to the velocity of light, β ; $G = 1/(1 - \beta^2)^{1/2}$; βG ; the energy in electron kilovolts, and the curvature of the electron path in a magnetic field times the field $H\rho$. The total energy, effective mass, and momentum depend on the functions G and βG . The energies cover the range from 6 to 10^{10} electron volts so that the tables are applicable in the full range of energies involved in nuclear and cosmic ray physics. In the range from 10,000 to 1.5×10^7 electron volts successive values differ by less than 1 percent in energy and curvature so that in nearly all practical problems the tables would be used without interpolation. As rela-

tivistic equations must be used throughout this range the tables will save a great deal of laborious computation.

Copies of MT17 are obtainable from the National Bureau of Standards, Washington, D. C. The price is \$1.50.

TABLE OF LEGENDRE POLYNOMIALS

The zeros of the Legendre polynomials of order 1-16 and the weight coefficients for Gauss' mechanical quadrature formula are tabulated in Mathematical Table MT18, obtainable from the Bureau at 25 cents a copy. This material was prepared by A. N. Lowan, N. Davids, and A. Levinson, and was originally published in the Bulletin of the American Mathematical Society for October 1942.

Gauss' method of mechanical quadrature has the advantage over most methods of numerical integration in that it requires about half the number of ordinate computations. This is desirable when such computations are very laborious, or when the observations necessary to determine the average value of a continuously varying physical quantity are very costly. Gauss' classical result states that, for the range $(-1, +1)$, the "best" accuracy with n ordinates is obtained by choosing the corresponding abscissas at the zeros x_1, \dots, x_n of the Legendre polynomials $P_n(x)$. With each x_i is associated a constant a_i , such that

$$\int_{-1}^1 f(x) dx \approx a_1 f(x_1) + a_2 f(x_2) + \dots + a_n f(x_n)$$

gives the roots x_i for each $P_n(x)$ up to $n = 16$, and the corresponding weight coefficients, a_i , to 15 decimal places.

TABLE OF CONFLUENT HYPERGEOMETRIC FUNCTIONS

Confluent hypergeometric functions occur in numerous physical problems. They appear in the solutions of Laplace's equation and the equations of wave motion and of diffusion when the physical problem involves knife edges, parabolic cylinders, paraboloids of revolution, general ellipsoids, etc. Of particular importance to the quantum physicist is their occurrence as the solutions of the radial part of Schrödinger's equation for a Coulomb field and continuous values of the energy. Thus they are needed for the calculation of the scattering of charged particles from atomic nuclei, or of their binding by nuclei. In a more general form they also occur in the problem of dissociation of molecules into atomic ions (and, of

course, in the converse case of the formation of molecules).

Mathematical Table MT19 in the series prepared by the Work Projects Administration for the city of New York and sponsored by the Bureau, contains a table of the function $H(m, a, x)$ and its first derivative for values of x from 1 to 10 by steps of 1, for values of a from 1 to 10 by steps of 1, and for values of the integer m from 0 to 3. The values in all cases are given to seven significant figures.

The table has been reprinted from the Journal of Mathematics and Physics for December 1942; copies are obtainable at 25 cents each from the National Bureau of Standards, Washington, D. C.

QUANTITY STANDARDIZATION IN RETAIL TRADE

The principles of quantity standardization, consistently upheld by the Bureau since its establishment and recognized as fundamental in weights and measures regulatory work, are formally set forth, with particular reference to retail packages, in Letter Circular LC-726 which has just been released.

These guiding principles—that commodities should be offered for retail sale only in certain standard units of weight and measure, that only multiples and binary submultiples of the basic unit should be permitted, and that any series should be restricted to sizes that are “self-defining” as to quantity of content—are recommended for observance by packers in all current and future simplification programs. The principles apply not only to the size standardization of containers, such as bottles, cans, cartons, bags, and the like, which control the quantity of a commodity (as, for instance, a carbonated beverage in which the size of the bottle governs the amount of liquid offered for sale), but also to the quantity of the retail unit of a commodity (for example, a loaf of bread) when this is not dependent upon the capacity of a container of fixed size.

The observance of the recommended principles would be advantageous to packers because it would mean the elimination of the quantity factor (the amount of the commodity in the retail unit) as a competitive consideration in any specific industry, provided that standardization is industry wide, a possibility that should appeal strongly to all ethical packers. Marketing would be simplified with consequent reduction in costs by reason of fewer retail units, reduction of container and of package inventories, standardization of shipping containers, simplification of cost accounting and billing, simplification of

procedure under OPA price regulations, and general increased dealer and consumer satisfaction.

Dealers, in turn, would benefit from simplified marketing and OPA procedure, and from better satisfied customers.

Consumers would find such standardization advantageous because it would make possible the establishment of an equitable system of “point” values which would result in point economies. Comparable packages of competing brands would contain equal amounts of a commodity, and comparative unit costs would be established at once by package prices.

Finally, the consumer would benefit from the elimination of the quantity variable from the three-factor “purchasing equation”, only the quality and price variables would remain, and these must always be evaluated by the purchaser, with resulting intelligent and economical buying.

Copies of LC726 are obtainable without charge from the National Bureau of Standards, Washington, D. C.

NEW AND REVISED PUBLICATIONS ISSUED DURING JUNE 1943

Journal of Research ²

Journal of Research of the National Bureau of Standards, volume 30, number 6, June 1943 (RP1541 to RP1544, inclusive). Price 30 cents. Annual subscription, 12 issues, \$3.50.

Research Papers ²

[Reprints from the April and May 1943 Journal of Research.]

RP1532. Further experimental study of beater practice in the manufacture of offset papers. Charles G. Weber Merle B. Shaw, and Martin J. O'Leary. Price 5 cents.

RP1534. Some properties of heat-setting refractory mortars. Raymond A. Heindl and William L. Pendergast. Price 5 cents.

RP1536. Nature of the prismatic dark interstitial material in portland cement clinker. William C. Taylor. Price 15 cents.

RP1537. Dissociation constants and pH-titration curves at constant ionic strength from electrometric titrations in cells without liquid junction: Titrations of formic acid and acetic acid. Roger G. Bates, Gerda L. Siegel, and S. F. Acree. Price 5 cents.

² See footnote on page 8.

RP1538. Function of carbon dioxide in producing efflorescence on plaster and cement products. Dana L. Bishop. Price 5 cents.

RP1539. Study of the system $\text{CaO-Al}_2\text{O}_3\text{-H}_2\text{O}$ at temperatures of 21° and 90° C. Lansing S. Wells, W. F. Clarke, and H. F. McMurdie. Price 10 cents.

RP1540. Perforated cover plates for steel columns: Compressive properties of plates having a net-to-gross cross-sectional-area ratio of 0.33. Ambrose H. Stang and Martin Greenspan. Price 10 cents.

Simplified Practice Recommendations ¹

R17-43. Heavy forged hand tools. (Supersedes R17-35.) Price 10 cents.

Commercial Standards ²

CS(E)107-43. Commercial electric-refrigeration condensing units. Price 10 cents.

Technical News Bulletin ²

Technical News Bulletin No. 314, June 1943. Price 5 cents. Annual subscription, 50 cents.

¹ Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, \$3.50 a year (to addresses in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and \$4.50, respectively.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC725. Quality classification and inspection of precision gage blocks.

LC726. Some notes on standardization with particular reference to retail package sizes.³

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS³

Time: Its determination and use. Ralph E. Gould. The Tuftonian (Tufts College, Medford, Mass.) **3**, No. 4, 156 (May 1943).

Standards' role in gaging war effort. Hugh G. Boutell. Domestic Commerce (Department of Commerce, Washington, D. C.) **31**, No. 19, 13 (June 1943).

The center of shear again. W. R. Osgood. J. Applied Mechanics (Am. Soc. Mech. Engineers, 29 West 39th St., New York, N. Y.), **10**, No. 2, A-62 (June 1943).

National Bureau of Standards. Lyman J. Briggs. The Pyramid of Sigma Tau (C. A. Sjogren, 201 South 30th St., Lincoln, Nebraska) **27**, No. 4, 17 (Spring issue, 1943).

³ These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

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